CONSERVATION

of Our Renewable Natural Resources

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SUGGESTIONS FOR SCIENCE FAIR PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOLS

2 AGRICULTURAL STABILIZATION AND
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References given in this reprint were compiled in 1959 for use of schools in the Wash., D.C. area. For use in other areas, references should be adjusted on the basis of materials locally available.

Information about the availability of U.S. Department of Agriculture publications mentioned in the references is given below.

Copies are free unless otherwise indicated. Where price is given copies may be purchased from the Government Printing Office. Those marked "Out of Print" can usually be consulted in most libraries.

A.B. 106 - Our Productive Land...We Can Conserve and Improve it While Using it. Slightly revised 1961. 10¢.
A.B. 172 - Credit in Use and Conservation of Agricultural Resources. October 1957.
A.B. 175 - More Wildlife through Soil and Water Conservation. March 1958.
A.H. 30 - Testing Agricultural and Vegetable Seeds. 1952. $4.00.
C. 910 - Some Plant-Soil-Water Relations in Watershed Management. October 1952. 20¢.
F.B. 2003 - Legume Inoculation: What it is; What it Does. December 1948.
F.B. 2035 - Making Land Produce Useful Wildlife. Rev. November 1960.
L. 249 - What is a Conservation Farm Plan? Slightly Rev. 1961. 10¢.
L. 328 - Your Soil...Crumbly or Cloddy? August 1952.
P.A. 341 - Teaching Soil and Water Conservation - A Classroom and Field Guide. December 1957.
T.B. 1162 - Economic Evaluation of Use of Soil Conservation and Improvement Practices in Western Iowa. June 1957. 35¢.
T.B. 1166 - A Summary of Research Experience with Stubble-Mulch Farming in the Western States. October 1957.
Yearbooks of Agriculture - 1948, Grass, $2.00; 1952, Insects, $3.25; 1955, Water, $2.25; 1957, Soil, $2.25; 1958, Land, $2.25.

A.B. 63 - Books, Booklets, Bulletins on Soil and Water Conservation. September 1951. Out of Print.
ATLAS OF AMERICAN AGRICULTURE, "Part III - Soils of the United States". BAE. July 1935. Out of Print.
F.B. 1789 - Terracing for Soil and Water Conservation. April 1938. Out of Print.
L. 82 - Controlling Small Gullies by Bluegrass Sod. December 1931. Out of Print.
M.P. 702 - Will More Forage Pay? Economic Aspects of Using More Pasture and Forage on Farms. A Progress Report. November 1949. Out of Print.
P.A. 337 - Water Facts. August 1957. Out of Print.
T.B. 1102 - Root-Growth Stoppage Resulting from Defoliation of Grass. February 1955. Out of Print.

1/ "Projects for Young Scientists" may be obtained from the Joint Board on Science Education at cost of $1.25 per copy.

CHAPTER NINE

Conservation Projects

Modern soil, water, forest, and wildlife CONSERVATION has been called "the newest science." Conservation in this sense means more than the dictionary shows. It is by various definitions—

— the use of the natural resources for the greatest good of the greatest number for the longest time.
— the use of each acre of agricultural land within its capabilities and the treatment of each acre in accordance with its needs for protection and improvement.
— balanced use of resources.
— use without using up.
— stewardship of the earth's bounty.
— man and land in harmony.

Conservation affects all of us—our food and fiber and wood, our water, our recreation, even our conquest of space. It is **everybody's business,** for now and for the future.

By 1980, we may have 250 million Americans—more people to the acre every year, more crowded suburbs and countryside. And we are converting many acres of open and wild land to houses, highways, airports, and industry, and losing much soil by water and wind erosion. We shall always need good soil, water, trees, wildlife, and recreation areas.That means more conservation **now.**

What makes a science fair exhibit a conservation exhibit? It is one or more other sciences plus - for example, botany or biology **plus**, chemistry or physics **plus,** or mathematics **plus. That "plus"** is the challenge, the something that makes the exhibit **live.** Conservation vitally affects people; therefore, a conservation project will have elements of social sciences, as well as physical or life sciences. If the exhibit shows how the conservation demonstration applies to and affects people, the exhibit will be interesting, educational and challenging to the viewers.

Perhaps the following topics and the references cited will suggest a conservation project. Obviously, they are only sug-

These project ideas were compiled by a committee from the Washington D.C. Chapter of the Soil Conservation Society of America and the National Capital Section of the American Society of Range Management.

gestions, far from all-inclusive. In fact, each one may suggest several others. But do not try to show too many things by your research and demonstration. Instead, seek to demonstrate some specific truth that is based on conservation.

If the suggestions broaden your horizon a bit, help you see the good land and other resources that can be protected and improved, they will have served their purpose. Remember, too, that workers in conservation organizations (your soil conservation district; soil, water, forestry, or wildlife groups; State, Federal, or Land-Grant College agencies with conservation responsibilities in research, education, technical service, cost-sharing or credit) will be glad, within their available time, to supply further information on a specific question if you request it.

Conservation Education

Knowledge of the part soil and water resources play in our living is an important responsibility of citizenship. Conservation of these important resources is taught in many schools today. Some people have a better chance to observe and learn the effects of these resources on living because of their surroundings or their friends and family.

But too many students still grow up without sufficient knowledge of the importance of protecting and improving the land from which we get most of our food and much of the material for our clothing and shelter.

How much do the students in your class or your school know about conservation? Do farm-raised students know more about it than those who have lived only in the city, or in the suburbs? What do they know most about—Soil? Water? Forests? Wildlife? What phases of conservation education need more attention in your school?

A survey or questionnaire, with the results plotted to show the answers to some of these questions, would make an interesting and valuable science fair exhibit.

References

Hill, Wilhelmina, The Three R's and Resources, (1959) 10c. National Wildlife Federation, Washington, 12, D.C.

Giles, Robert H. Jr., Conservation Knowledge of Virginia School Pupils, Bulletin 257, Virginia Polytechnic Institute, Agricultural Extension Service, August (1958).

U.S. Department of Agriculture, Our Productive Land, Agr. Info. Bul. 106 (SCS).

Causing People to Become Conservationists

Conservation of our renewable resources takes many forms. It is practiced by the farmer who runs his crop rows on the contour instead of in convenient straight lines, by the timber owner who does selective cutting and reforestation, by the factory owner who keeps his mill wastes from polluting streams, by school children and scouts when they plant trees or develop wildlife shelter, by all of us through tax supported conservation programs.

Conservation does not just happen. It is the result of someone's labor. That means someone must want it done. To get conservation done the farmer or the lumberman, the mill owner or the teacher, the scoutmaster or the taxpayer must be made aware of the importance of conservation to him. He must want to get it done and learn how to go about it. This might apply to a class in a school or to your county government, as well as to an individual.

How to cause people among such groups to become conservationists — to stimulate individual or group or civic action — offers a big challenge in the field of conservation education today. It is a challenge to the best skills in the graphic arts, the various mass information and news media, the whole broad range of the art of teaching and convincing. How would **you** do it - prove your method effective - with one of these groups?

References

Any illustrated encyclopedia, "Conservation."

Hill, Wilhelmina, The Three R's and Resources, 1959. 10c National Wildlife Federation, Washington 12, D. C.

Value of Conservation Practices

Conservation of land and water resources—especially through construction of lakes and ponds, establishing or preserving woodlands, maintaining meadows, and preventing stream channel erosion—adds materially to the attractiveness of the countryside and to the facilities for recreation. These measures may make the land more productive and more valuable. Building ponds and doing other things for conservation, however, cost money, sometimes a great deal of money. Studies to determine what these measures are worth to the landowner and to the community in comparison to what they cost would be very valuable in helping people decide on the kind of conservation program to undertake.

References

Land, The Yearbook of Agriculture, (1958), USDA, Washington, D.C.

Upchurch, M.L., USDA, "Longtime Investments in Soil Management" Soil, The Yearbook of Agriculture, (1957), pp. 441-50.

Ciriacy-Wantrup, S. V., Dollars and Sense in Conservation, Calif. Agric. Expt. Sta. Cir. 402, (Jan. 1951).

Farm Ponds for Conservation and Use of Water

Rainfall is often quite below average in many areas. In these years, the wells or farm streams may not produce enough water to supply all needs for home and livestock. Many farmers have built dams across small watersheds to catch rainwater which otherwise would run off to the ocean. Generally, a relatively small area, say 4 acres, is sufficient to supply enough water for a livestock water pond. (These ponds may provide much good recreation, too.)

Ponds need to be quite large to provide enough water for irrigation for field crops. Ten to 15 acres or even more may need to be in the watershed. But a garden can be irrigated by the water saved by even a relatively small pond.

Significant charts and graphs could be developed assuming varying seasonal deficits of rainfall from the Washington area average and showing:

1. Acre-feet of water storage in ponds needed to replace the deficits.
2. Watershed areas needed to collect rainfall runoff in those ponds (remember water losses).
3. Acres of apple orchards that could be sprayed during a normal spray season from such ponds.
4. Number of cattle or other types of animals for which such ponds would supply adequate water for drinking, for washing of equipment, etc., for a specified number of months.
5. Capacity of a pond needed to provide supplemental water for an average (specified size) lawn or garden.

Reference

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C. (See "irrigation", "ponds", "reservoirs", "livestock water needs", etc.)

Suburban Soil Erosion

Cutting all trees and bringing all lands to new grades in suburban building developments is very contrary to good soil and water conservation practices because during the development period and for years thereafter the soil has little or no protection from water erosion.

1. Show two areas on opposite sides of a stream or on different streams, one denuded, the other with houses among the trees and with cleared areas for gardens.

2. Show differences in stream turbidity (color and "load) after a rain when the area is wooded, as compared with a denuded area, either bare or recently seeded or sodded.

References

J. H. Stallings. Soil Conservation. Prentice-Hall, Inc., Englewood Cliffe, N. J., (1959).

J. H. Stallings. Soil Use and Improvement. Prentice-Hall, Inc., Englewood Cliffe, N. J., (1957).

Urbanization and Conservation

One of today's most critical conservation problems is the effect of rapid expansion of cities into farm areas, with resultant loss of good food-producing land, increased floods and sedimentation, reduction of recreation areas, etc. Cities must expand, of course, as our population grows. But there are ways of selecting land best suited for urbanization and then handling it in ways to minimize the ill-effects of urbanization.

An exhibit showing a land area before and after urbanization under good practices and under bad practices would be very informative.

References

Beaumont, A. B., "Suburban Conservation". Soil Conservation, 24(7): 147-50. (Feb., 1959).

Dale, Tom, "Under all is the Land." Soil Conservation, 23(3): 51-56. (Oct., 1957).

White, W. H. Jr., "Urban Sprawl." Fortune, 57(1): 103-109, 194, 198, 200. (Jan., 1958).

Williams, D. A. "Urbanization of Productive Farmland." Soil Conservation, 22 (3): 60-65. (Oct., 1956.)

Conservation of a Small Watershed

If the conservation problems were corrected on enough small watersheds (the drainage basins of small streams), big conservation problems (floods, water shortages, dust storms, extensive soil loss or deterioration, etc.) would be solved. These problems are important to both rural and city people. Making citizens (youth and adults) aware of the problems and possible solutions is the first step. There is a **miniature watershed** on practically each school ground or nature trail. Why not identify the conservation problems on one, plan their solution, and carry out the plan on the ground? Then why not make and exhibit a model of that watershed, along with a poster listing and picturing the conservation practices installed?

References

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C., (e.g., pp. 161-218).

Teaching Soil and Water Conservation, USDA, PA-341, (Dec. 1957) (pp. 28-30).

A Rurban Watershed — Rock Creek in the Nation's Capital. Allis-Chalmers Mfg. Co., Milwaukee, Wisc., (1959).

Water

Water is probably the most critical natural resource in our country today. Where it is available, in what quantity and quality determines whether agriculture can expand, whether new industries can be located, and even affects the growth of cities.

Man's use of the land affects the behavior as well as the supply of water. A challenging science fair exhibit might be built around what man can do to improve the quality and quantity of water for a community. This might be a graphic description of watershed management, including erosion control and flood prevention, control of pollution and sedimentation, development of water storage, reduction of evaporation losses, and many other factors of good water and watershed management.

Check with local offices of the Department of Agriculture to see if there is a watershed protection and flood prevention program underway in your area. If so, the plans and progress of this project will provide a good basis for your study.

References

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C.

Water Facts. USDA PA-337, Soil Conservation Service, Washington, D.C.

Teaching Soil and Water Conservation. USDA PA-341, Soil Conservation Service, Washington, D.C.

Books about Water. USDA SCS-CA-6, Soil Conservation Service, Washington, D. C.

The Leaky Faucet

Most homes and apartments at one time or another have a leaky faucet. The amount of water lost from **one** leaky faucet could be measured. This figure could then be used to estimate the amount of water lost from this cause during a year in all the homes in the city, state, or nation. Charts could be developed showing how much this water cost, or how valuable it would be if saved and used for growing gardens and crops, filling swimming pools, cooling factories, or other purposes.

References

Water Facts. USDA PA-337. Soil Conservation Service, Washington, D.C.

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C.

Books about Water. USDA SCS-CA-6. Soil Conservation Service, Washington, D.C.

Water Conservation for Cities

More and more water is being used both by agriculture and by cities. Irrigation is expanding in the more humid areas. Water consumption is expanding even more rapidly in the urban areas. Many cities already have taken water formerly used by agriculture. Some have had to impose water rationing on their citizens. The job of providing increased quantities of water and of

maintaining or improving quality of water for cities is increasing and becoming more costly. Could you make a study that would reveal the future needs for water both for agriculture and for urban uses in your area? Such a study would be very valuable for planning for future water supplies.

You could secure estimates of agricultural uses of water in the past from the Bureau of the Census. Estimates of urban uses, both for industrial purposes and for human consumption, could be obtained from the Planning Commission or other city officials. You could develop charts showing water consumption in the past by type of use and you could project these into the future on the basis of trends in population.

Reference

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C.

How Much Water does a Plant Use

The amount of water used by plants is important in determining species to be used in plantings, especially where the water supply is limited.

The water requirement of grass can be determined by carefully following relatively simple procedures. Gallon confectioners' cans make suitable containers. The plants should be started as cuttings and after rooting must be grown for two or more months in a known amount of soil, and all water applied must be measured. Loss of moisture by evaporation from the soil surface can be greatly reduced by a surface mulch or cover. The dry weight of plant material produced is divided into the weight of water used to obtain the water requirement.

References

Keller, Wesley. "Water Requirement of Selected Genotypes of Orchardgrass." Agronomy Journal 45. (Dec., 1953).

Keller, Wesley. "Water Requirement of Dactylis glomerata L. in the Greenhouse as Influenced by Variations in Technique and Their Interactions." Agronomy Journal Vol. 46, No. 11, (November, 1954).

The Hydrologic Cycle

The continuous circulation of water in Nature, through the processes of evaporation and condensation, is known as the hydrologic cycle, and is essential to life on this planet. The process can be materially influencd by the way man uses and cares for his land. Therefore, it is important for everyone to know what happens in this cycle and what we can do in soil conservation and land use programs to avoid wasting water and damaging the soil.

A model, diagram, or series of drawings or photographs describing the processes involved and the effect of land use on the hydrologic cycle could present a highly important and valuable story. The construction of a really effective exhibit of this kind

offers a challenge to the inventive as well as the scientific-minded student.

References

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C. 751 pp. See esp. p. 41. "From ocean to sky to land to ocean," by Ackerman, Coleman, and Ogrosky.

Foster, E.E., Rainfall and Runoff. Macmillan Co., Inc., New York, (1952).

Measurements of Soil Moisture

Water in the soil is an important element in the hydrology of a watershed. Soil is one of the principal natural reservoirs for the storage of the water that falls on the land as rain, snow, or other forms of precipitation. Measurements of the moisture in the soil help answer many questions about the hydrology of an area.

Instruments are available for measuring the moisture in the soil in place. Electronic devices can be used to make a continuous record of the measurements and/or to transmit them to a central location.

Some of the problems that can be studied by measuring moisture in the soil are:

1. **Effect of plant cover on water intake.** Install soil moisture instruments in two areas of a similar soil with different plant cover (or one bare area); install or use data from rain gage nearby. Calculate the increase in moisture content of the soil resulting from each rain; compare amount or rate of gain (intake) of the two plots. How does this affect runoff from the area?
2. **Effect of different kinds of vegetation on evapotranspiration.** With instrumentation as described in item 1, compare rates of moisture depletion on the two areas after rains that saturate the soil. Calculate the moisture-storage capacity of the soil and its possible effect on runoff.

References

Blanc, M. L., (1959) "Soil Moisture Reporting." Weekly Weather and Crop Bul. 46(13): 7-8. Mar. 30 U.S. Weather Bureau, Washington, D.C.

Lassen, Leon, Lull, H. W., and Frank Bernard, (1952). Some Plant-Soil-Water Relations in Watershed Management. USDA, Circ. 910. Washington, D.C.

Water, The Yearbook of Agriculture, (1955), USDA, Washington, D.C. pp. 41-51, "From ocean to sky to land to ocean"; pp. 151-159 "How much of the rain enters the soil?"; pp. 362-371 "How to measure the moisture in the soil."

The above publications list additional references.

Methods and Economics of Reducing Erosion on Farmland

There are mechanical ways of reducing soil erosion on hilly land, such as terrace systems, contour farming, stripcropping, etc. and there are vegetative methods, Models, drawings, photographs, etc. may be used to illustrate these.

Yet many family gardens—both vegetable and flowering—lose much of their topsoil (and therefore ability to produce) from erosion. Do the gardens you know about have little rivulets running downhill between the rows or plants where the soil has eroded away? Over a few weeks a check on this can be made by getting some 18-inch stakes and painting about half-way down and driving the stakes into the soil as far as the paint. Put the stakes about three or four feet apart. After each rain or a number of rains; draw a string between two stakes at the former surface level and see how deep the rivulets are.

How much top soil has been lost? Estimate the average depth of the erosion and how many eighth's of an inch the thickness would be if smoothed out evenly. From this, compute how heavy the soil is—how many tons per acre have been lost—as conservationists do. How much decrease in yields might result? How much harder would it be to make an income on eroded land?

Estimate the soil and yield losses in different types of relatively clean cultivated land uses and in a grassy area of similar topography.

References

"Conservation" and "Erosion" in any encylopedia.

Foster, A. B. and Fox, A. C., Teaching Soil and Water Conservation—a Classroom and Field Guide (pp. 19 and 20), USDA PA-341, (Dec. 1957).

Soil, The Yearbook of Agriculture, (1957), USDA, (e.g. pp. 290-307).

Terracing for Soil and Water Conservation, Farmers Bul. 1789, USDA.

Will More Forage Pay? USDA, Misc. Bul. 702.

Controlling Small Gullies by Blue Grass Sod, Leaflet 82, USDA.

How Grass Grows

Grass, like other green plants, grows by manufacturing food through the process of photosynthesis in the green leaves. If too much of the foliage is removed, as in mowing a lawn, growth is slowed down and sometimes the plants are killed.

To determine the effect of foliage removal on growth of grass, study two plots of lawn mowed at different heights. Mow both plots on the same day, cutting one with the mower set as low as possible and the other as high as possible. Before each mowing, record observations on the density and vigor of the grass, height or length of blades, presence of weeds, and other features that indicate the condition of the lawn. The results of these observations continued for several months could be shown on charts and illustrated by samples of the sod from the two plots.

Reference

Crider, F. J., Root-growth stoppage resulting from defoliation of grass. USDA, Tech. Bul 1102. Washington, D.C., (1955).

Influence of Mowing and Grazing on Grasses

Conservation use of pasture and range plants is necessary to keep them in good high producing condition. To demonstrate this,

plant grasses such as crested wheatgrass, meadow fescue, bromegrass or others in near-gallon cans filled with soil and with perforated bottoms to facilitate drainage. Grow in full sunlight. Clip the plants weekly at heights of 1/2, 2 and 4 inches for a period of 8 to 12 weeks. At the end of the period, submerse the cans of soil in water for 24 to 48 hours. Remove soil and plants from cans and gently wash soil from roots to show the effect of height of cutting upon root development. Results may be displayed by mounts of plants, photographs, charts, etc.

Reference

Weaver, I. E. and F. E. Clements. Plant Ecology. McGraw Hill. New York, (1938).

Effect of Clipping on Root Development

The amount of top growth removed from plants and the frequency of this removal has a great deal to do with root growth and consequently the ability of plants to absorb nutrients and moisture from different soil depths.

Grow seedlings in pots and subject them to various clipping treatments, including height of cut and frequency (daily, weekly, etc.). Measure root development, amount of top growth, etc. It would be desirable to include more than one species, e.g., annual ryegrass and Kentucky bluegrass. This study could be supplemented by a height of clipping test on a home lawn. Photographs taken in the spring and fall and sod samples dug in the fall would be useful in reporting on a home demonstration.

References

Grass, The Yearbook of Agriculture, (1948), USDA, Washington, D.C.
H. B. Musser, Turf Management. McGraw Hill Book Co.,. Inc., New York, (1950).

Effect of Major Elements on Growth of Kentucky Bluegrass

On many soils it is essential that proper fertilization be done to maintain an adequate desirable plant cover. Such cover is needed to conserve the soil as well as maintain high production.

Plant Kentucky bluegrass seed in one series of pots filled with subsoil and in a second, filled with garden soil. Possible treatments might include no fertilizer, a complete fertilizer (10-10-10), nitrogen only (ammonium sulfate or ammonium nitrate), phosphorus only, and potassium only. The complete fertilizer treatment and the single fertilizer treatments should be comparable with respect to the amount of nitrogen, phosphorus and potassium applied. Harvest two replications and display two. Measure roots and tops and include weight if possible. Study could be supplemented by fertilizer experiment on a small portion of a home lawn.

References

Grass, The Yearbook of Agriculture, (1948), USDA, Washington, D.C.
H. B. Musser, Turf Management. McGraw Hill Book Co., Inc., New York, (1950).

Differential Response of Grass and Legumes to Nitrogen And Phosphorus Fertilizers

An important phase of conservation plans is to select fertilizer treatments which favor the plant cover desired. Nitrogen stimulates grass growth while having less effect on legumes. Phosphorus stimulates legume growth but has little effect on grass. Rooted cuttings of uniform size of grass and alfalfa, from a single plant of each, will provide a striking demonstration of these relationships when grown in gallon cans and given different fertilizers. For best results each treatment should be in duplicate and the experiment should continue at least two months. Suggested fertilizer rates: 200 lbs., N or 100 lbs. P per acre. Check with biology teacher as to treating all cans with K. Growth curves can be obtained by periodic measurement of plants by Crider's technique.

Reference

Crider, Franklin J., Root-growth Stoppage Resulting From Defoliation of Grass, USDA Tech. Bul. 1102. (Feb. 1955).

Selective Action of Herbicides on Weed and Forage Plants

Plant rows of seeds of oats, red clover, and ladino clover 1/4 inch deep in each of 4 pots or near-gallon cans. In three of these pots scatter over the surface a mixture of seeds of broad-leaved plants such as rape, mustard or lettuce to represent broadleaved weeds and lightly cover with soil. Grow the plants in full sunlight for a period of 3 weeks. The pots having a mixture of legumes, oats and plants representative of weeds should be given differential treatment at this time: (a) Spray one pot at a calculated rate of 1 lb. of 2,4 dichlorophenoxyacetic acid (2,4-D) per acre, (b) spray a second pot at a calculated rate of 1 lb. of 4-(2,4-dichlorophenoxy) butyric acid (4-(2,4-DB)) per acre, and (c) give no spray treatment to the third. Continue to grow plants in full sunight for an additional period of 3 to 6 weeks.

This demonstration will show the effect of broad-leaved plants in competition with legume seedlings, in comparison with the weed free condition. Also, the 2,4-D spray treatment will eliminate both weeds and legumes and leave the oats relatively uninjured while treatment with 4-(2,4-DB) should remove the "weed" species without injury to the legumes or oats. What are the principles of selectivity?

Herbicidal chemicals can be obtained from commercial companies such as Amchem Products, Inc., Ambler, Pa.; Dow Chemical Co., Midland, Mich.; Chipman Chemical Co., Roundbrook, N.J.; and others. It is important that chemicals be applied to the foliage of the plants at the rates of application recommended.

Reference

Ahlgren, Klingman, and Wolf, Principles of Weed Control. John Wiley & Sons, Inc., New York. (1951).

Effect of Environment on the Germination of Grass Seed

Germinate seed of several lawn grasses using different media (sand, soil, blotting paper) and various temperature combinations. Experiments could include series with no light, partial light, alternating dark-light, and continuous light.

Reference

Testing Agricultural and Vegetable Seeds. USDA Handbook No. 30. (1952).

Effects of Competition on Plant Growth

Greater productivity may be realized along with proper soil conservation if optimum stand densities are received from plantings.

Competition occurs whenever two or more plants make demands for water, light, or nutrients in excess of the supply. Interesting results may be secured by planting different numbers of seeds in a series of pots or green house flats. The same species might be used throughout, or different species might be used. Results can be evaluated in terms of height, weight, fruit or flower stalk production, and recorded by photography, charts, or tables.

Reference

Weaver, J. E. and F. E. Clements. Plant Ecology. McGraw-Hill. New York, (1938).

Identification and Evaluation of Grasses

By Their Vegetative Characteristics

Identification of grasses by vegetative characteristics is often essential in evaluating pastures, lawns and conservation plantings. Grow seed of known grasses in flower pots or flats and make field collections. Determine characteristics that distinguish common grasses. Display drawings of characters used to differentiate species, mounted specimens and growing seedlings. What characteristics make grasses valuable as soil-binding and moisture-conserving plants? Exhibit could include pressed, dried specimens, as well as the growing plants and charts.

Reference

— The Identification of 76 Species of Mississippi Grasses by Vegetative Morphology, Mississippi Agricultural Experiment Station Technical Bulletin 31, (1952).

Plant Ecology

Ecology is the study of the relation of organisms to their environment and to one another. An important phase of plant ecology is the effect of changing soil environment on the plant life it will support at a particular time. Knowing what kind of soil

environment is most favorable for a particular plant or tree is important in planning soil conservation and good land use. The effect of changing soil conditions on the growth of plants might be the subject of an interesting study in plant ecology.

References

Daubernmire, R. F., Plants and Environment. John Wiley & Sons, Inc., New York. (1959).

Soil, The Yearbook of Agriculture (1957). USDA, Washington, D.C., 784 pp. See esp. p. 38.

Stallings, J. H., Soil Conservation, ch. 7, 8, and 11. Prentice-Hall, Inc., Englewood Cliffe, N.J., 1957).

How Seeds Travel

It is well known that seeds of importance in soil and water conservation are widely dispersed by wind, water, birds, and other animals. They have special organs adapting them for the different forms of hitch-hiking, as the parachute-like hairs of the thistles and dandelions, the hard light hulls on the seeds of littoral plants, and the hooks and glands that adhere to hair or skin. Every seed, as goes the song of the boll weevil, is "looking for a home". Relatively few of the millions of seeds find a proper spot for their germination and growth to a plant, but when this happens by nature's chance, they have found their home and perhaps helped solve a conservation problem. This process the botanist calls ecesis (from Greek), a short word but laden with meaning. Wherever we live, new or wayfaring plants can be found. To the inquiring mind the kind of soil and site they grow in and the types of seeds they bear—the different types make a good exhibit—are clues for the scientific detection of their identity, origin, and how they got there.

Observe an area of earth that was bare a year or two ago, chart its plant population, where the plants probably came from, how they got there (related to the different types of seeds), how many kinds, and how they compare with those in a nearby undisturbed area.

References

Ridley, Henry N. The Dispersal of Plants Throughout the World. (1930), L. Reeve & Co., Ltd.

Any illustrated encyclopedia, "Seed".

Value of Plant Residues

Several small plots could be set up in the garden or backyard to study the value of plant residues (leaves, straw, etc.) as an aid for (1) conserving moisture, (2) improving soil tilth, (3) building up soil fertility, or (4) other soil and water conservation benefits.

One of the plots could be kept cultivated so no vegetation would grow. Different kinds of plant residues could be applied to the others; e.g., leaves on one, clippings from the lawn on another,

and peat, barnyard manure, or combinations of residues with commercial fertilizers on still others.

The purpose of this project would be to learn how plant residues can be used to improve soil conditions and conserve moisture. The results of the year's observations could be shown by charts and demonstrated at the Science Fair.

Reference

Stallings, J. H., Soil, Use and Improvement. ch. 10 and 15. Prentice-Hall, Inc., Englewood Cliffe, N.J., (1957).

Mulching For Moisture Conservation

Lack of moisture for growing crops and pasture, as well as wind erosion, is a major problem in the Plains States of the Midwest and West. Farmers try to leave the soil in a receptive condition so that the rain or snow that falls may be conserved to permit the growth of food, feed, and cover crops. One way of doing this is to stubble-mulch, which leaves a large part of the grain stubble above ground. Any rain or snow that falls is immediately caught and much of it held even on the more sloping land. Snow is readily caught in the stubble or on cloddy ground. In addition, the wind is not so likely to erode the soil or blow out small grain seedings. The costs of this type of cultivation are somewhat less than plowing so that the farmer gains two-fold by following a modern cultivation system.

While moisture problems vary by area, there are likely to be quite dry periods almost anywhere, that adversely affect plant growth and production. The results of mulching for moisture conservation might be demonstrated in a garden by putting peat, straw, or grass clippings around two or three rows of beans. Do the mulched rows produce more? What is the effect if a part of the beans is irrigated or watered frequently?

References

"Conservation" and "Erosion" in any encyclopedia.

Lingg, A. W. and Whitfield, C. J., Stubble-Mulch Farming, Bul. 1166, USDA, Washington D.C., (Oct. 1957).

Soil, The Yearbook of Agriculture, (1957), USDA. (See "Stubble" and "Stubble-mulch.")

Wildlife Habitat

Field borders between cropland and woodland are often unproductive and badly eroded. Crops do not do well close to the trees because trees take the moisture or make too much shade. Hence, there often is a "no-man's Land" at this point on the farm. If this border is planted to shrubs, especially those that bear fruit or berries, it will provide excellent food and cover for wildlife and will attract song and game birds, rabbits, and other animals. In addition, the shrubs will protect the land from erosion.

A season's wildlife count. comparing fields that have planted edges or borders with those that do not will reveal interesting and useful information about the effect of this conservation practice on wildlife populations. It may also reveal facts about food preferences, nesting habits, and other wildlife behavior.

You can get help from your county agent or local offices of the U. S. Department of Agriculture, in locating fields where such comparisons might be made. Be sure to get permission of the farmer, too.

References

Making Land Produce Useful Wildlife. USDA Farm. Bul. 2035.

More Wildlife Through Soil and Water Conservation. USDA Agric. Inf. Bul. No. 175.

Stream Pollution and Fish Conservation

River or other stream pollution by sewage and industrial wastes destroys fishing and other recreational resources. Showing the facts and helping the public to understand them can be a constructive conservation project and Science Fair exhibit. For example:

1. Model showing a "combined" sewer during heavy runoff of stormwater, emptying into the Potomac. This will require running water, color and open topped pipes. Benefit from correction of this system: Recreational use of river will be safe at all times. At present it is unsafe because of periodic over-flows of sewage after rains.
2. Picture exhibit of Blue Plains sewage treatment plant showing "primary" plant (dated) and "secondary" plant (dated, 1959). Information regarding capacity and other facts should be included. Benefits: As city grows, additional solids must be removed since these solids use up oxygen in the river which fish require to live. Elimination of odor in the river.
3. Two fish tanks. One equipped with oxygen supply and live fish. One without oxygen supply and dead fish. Benefit: Oxygen in water is required for fish to live. Also unsightly and smelly scum develops on water without oxygen.

Sources of information and assistance:

Interstate Commission on the Potomac River Basin, 203 Transportation Building, Washington 6, D. C.

Division of Sanitary Engineering, District Building, Washington, D.C.

U. S. Public Health Service, Division of Information, Washington 25, D. C.

Do Earthworms Help to Conserve Soil and Water?

Soil "aggregation" (crumb structure that is not readily broken down by rain) and soil channels made by macro-organisms are important to soil and water conservation. Earthworms improve the stability of some soil aggregates in water and, at the same time, make holes which increase water infiltration. Interesting experiments could determine the effects of earthworms on different soil properties and their possible influence on soil and water conservation.

A simple study of earthworms in action may be made as follows: Fill a container half full of loose black earth with several earthworms in it. Then add on top of that about half as much white sand or sawdust. Follow that by a half-inch of corn meal. Moisten daily with a small amount of water at house temperature. (If a glass container is used for easier observation, place inside a paper bag for darkness.) Record observations daily. Later, make studies of the composition of the sand or sawdust and earth layers, earthworm population, etc. Another container with a different mulch on top, or another kept at a different temperature, would provide interesting comparisons.

References

C. S. Slater and H. Hopp. Soil Science Soc. Amer. Proc. 12: 508-511. (1948).

C. S. Slater and H. Hopp. Jour. Agr. Res. 78(10): 325-339 (1949).

Soil, The Yearbook of Agriculture, (1957), (p. 164) USDA.

Insects and Wildlife Conservation

To understand the maze of inter-relationships existing in wild populations challenges the ingenuity of our best ecologists. Any altering or control measures applied to insects can further complicate the picture and offer a very interesting and challenging field of study. Insect counts before and after the application of insect control measures, can indicate which kinds of birds or other animals have had their food supplies altered. For example, learn when the county will carry on "fogging" operations to control mosquitoes or will spray to control certain tree insects. Take counts of various insects on plants in the sprayed area (1) before and (2) a day after. (Caution: If planning to apply any insecticides, remember that some are very dangerous to man and other warm-blooded animals.)

References

C. H. Hoffman and J. P. Linduska. The Scientific Monthly, LXIX: 104-114. August (1949).

Insects, The Yearbook of Agriculture, (1952). (pp. 699-731). USDA.

Insects and Soil and Water Conservation

Many insects are important in the breakdown of organic matter and in making holes in the soil, which increase water infiltration. Interesting research might classify the different insects

and other arthropods in forest floors or cultivated fields and tabulate their effects on the soil. The Berlese funnel and brine flotation method may be used to determine insect population.

Population counts before and after spraying might also be of interest. Does spraying change the amount or kind of activity going on in the soil? (Caution: Some insecticides are very dangerous to man and other warm-blooded animals.)

References

C. H. Hoffman, H. K. Townes, H. H. Swift, and R. K. Sailer. "Field studies on the effects of airplane applications of DDT on forest invertebrates." Ecological monographs 19:1-46. (Jan. 1949).

Insects, The Yearbook of Agriculture, (1952). USDA. (e.g., pp. 79, 291-292).

Soil, The Yearbook of Agriculture, (1957) (p. 163). USDA.

Soil Aggregate Formation

Soil that is crumbly is said to be "well-aggregated". This kind of soil structure is better for farming than cloddy or lumpy soil. We know that soil growing grass or trees usually is better "aggregated" than soil that has been in cultivation for a time. But exactly how or why this happens is not too well known. It is believed that water, soaking into the soil from a well-vegetated surface, carried with it in solution organic matter that helps to create this situation. Studies of the action of soil micro-organisms in connection with the organic matter in the capillary water, and possible effects of positive and negative charges on clay particles in the soil, would make interesting and useful projects.

References

Baver, L. D., Soil physics, ch. 5. John Wiley & Sons, Inc., New York. (1956).

Stallings, J. H., Soil Conservation, ch. 5 and 6. Prentice-Hall, Inc., Englewood Cliffe, N.J., (1957).

USDA Leaf. 328, Your soil, crumbly or cloddy. Washington, D. C.

Soil Bacteria, Nitrogen, and Humus

Many bacteria essential to higher life live on dead organic material and change it, making humus, an essential of good soil, an essential to plant growth and therefore to conservation. These bacteria can do this only when enough nitrogen is present for them to live and function. These organisms, too small to see by the unaided eye, are key operators in soil management and therefore to human life itself.

What happens to organic matter such as peat moss or leaf mold mixed with garden soil, treated with different levels or types of nitrogen fertilizer and a fixed amount of water? What happens to organic matter under (a) desert-like, (b) arctic-like, and (c) topic-like conditions? What if the soil used in the mixture is (a) acid, (b) neutral, or (c) alkaline? What hapens to plants seeded in the soil under the different conditions being observed? Care

must be taken to keep careful controls—one of which might be to have the organic matter and soil sterilized at the beginning of the experiment and kept moistened by distilled water.

References

Soil, The Yearbook of Agriculture, (1957), USDA (e.g., pp. 151-165).

Gibson, T., "Recent Progress in Soil Bacteriology", in World Crops, Vol. 3, No. 4, (Apr. 1951) (copies available from U.S. Dept. of Agri., Agri. Cons. Program Serv.)

Waksman, S. A., Soil Microbiology, John Wiley & Sons, Inc., New York 16, N.Y., (1952).

Cross-Slope Cultivation

Garden plots could be used to determine the effect of cross-slope (contour) cultivation on runoff and soil erosion. The plots should be near each other on the same kind of soil and the same steepness of slope. One plot would be cultivated across the slope and the other up and down the slope. Some device for catching and measuring the runoff water and soil lost from each plot would provide data for comparing the effects of the two methods of cultivation. Observations on a contour-farmed field during a rain would supplement the plot data. The results could be illustrated at the Science Fair by models in small boxes.

References

Stallings, J. H., Soil, Use and Improvement, ch. 13. Prentice-Hall, Inc., Englewood Cliffe, N.J., (1957).

USDA, PA-341, Teaching soil and water conservation. Washington, D.C.

Soil, The Yearbook of Agriculture, (1957) USDA, Washintgon, D.C. 784 pp. See p. 290, "Erosion on cultivated land", by B. D. Blakely, J. J. Coyle and J. G. Steele.

Selected conservation publications:

Conservation Education Association, Selected References on Conservation Education for Teachers and Pupils. 18pp. (1956), 15c, individual; rates on bulk orders. c/o Eastern Montana College of Education, Billings, Montana.

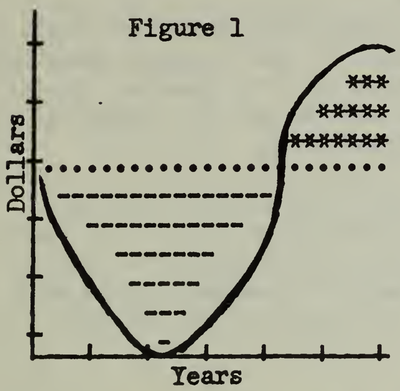
Soil Conservation Society of America, Conservationist's Library. 2 page leaflet. (1959), 838 5th Avenue, Des Moines 14, Iowa.

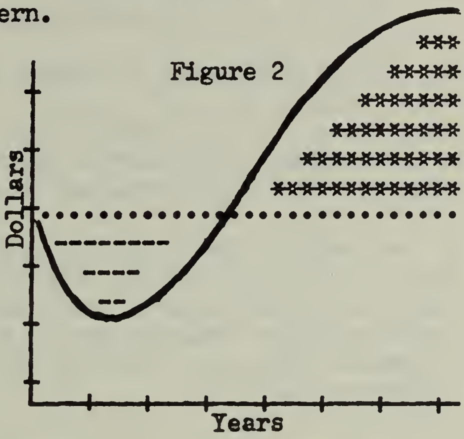
U. S. Department of Agriculture, Some References on Forests and Related Natural Resources (Forest Service), 0-15. 16pp. (1958).

U. S. Department of Agriculture, Books, Booklets, Bulletins on Soil and Water Conservation (Soil Conservation Service), Agriculture Information Bulletin No. 63. 30 pp.

MATHEMATICS OF INSTALLING CONSERVATION FARMING SYSTEMS 1/

The cost of conservation practices and frequently a lower farm income for a period of years are facts that discourage farmers from doing needed conservation work. The effect on income might look something like Fig. 1. Alternatives might make the effect like Fig. 2 or some other pattern.





...... = Assumed income if farming system is not changed.

= Assumed income if conservation system is installed.

------ = Reduced income period.

****** = Increased income period.

How can a farmer calculate whether he can "afford" to carry out a conservation system? Two or three alternative cropping and livestock systems might be assumed. Assumptions of stable prices and increases in crop yields, for example, of from 20 to 35 percent (2 to 5 percent per year) over a period of years might be made under various conservation systems of management. Optimum use of lime and fertilizer would be important. The Federal Government will share the cost (about 50%) of certain conservation practices and bear certain technical service costs. The family minimum living cost may require the borrowing of money. How much and when? Charts, graphs, and mathematical formulas and computations can be used. Models of a farm before and after treatment can illustrate systems and practices.

References:

Soil, The Yearbook of Agriculture, 1957, USDA, (e.g., pp. 267-276, 411-450). Land, The Yearbook of Agriculture, 1958, USDA, (e.g., pp. 316-338).

Ball, A. G., Heady, E. O., and Baumann, R. V., Economic Evaluation of Use of Soil Conservation and Improvement Practices in Western Iowa, USDA, Tech. Bul. No. 1162, June 1957.

Ciriacy-Wantrup, S. V., Dollars and Sense in Conservation, Calif. Agri. Expt. Sta. Cir. 402, Jan. 1951.

What is a Conservation Farm Plan? USDA, Leaflet No. 249 (SCS); Credit in Use and Conservation of Agricultural Resources, Agri. Info. Bul. No. 172, Oct. 1957; and Agricultural Conservation Program National Bulletin and a related ACP unpublished paper "Conservation Farming Pays - When?"

SOIL PROFILE EFFECTS

The proper management of a soil is often influenced by conditions beneath the soil surface. Soils of the Piedmont area are often underlain by granitic-type rocks such as granite, gneiss, or micaschist. Soil at the surface may be of good tilth, underlain by rotten rock which rests on hard rock.

On the coastal plain impeded drainage with mottled subsoils occurs frequently and may affect the use or results of use of the soil. Flat areas of the coastal plain frequently develop pan formations. The breaking of these is sometimes necessary for conserving water, but may be too expensive for general farm practice.

What happens to water infiltration and retention on different types of soil? Consider the same amount of rain on different types. Consider the same amount varied as to length of time of fall.

What happens when one attempts to grow conservation cover on different types of soil? Various crops and various types of treatment with the same crop might be recorded.

References:

Marbut, C. F., "Soils of the United States". In Atlas of Amer. Agr., Part III. 98 pages. 1935.
Any encyclopedia, "Soil".

SOIL-PRODUCED ANTIBIOTICS

The micro-organisms that produce the "wonder drugs" such as penicillin live in the soil, as well as in modern laboratories where they are put to work to produce antibiotics for medicinal and agricultural purposes.

But what is the effect of these same antibiotics in the soil? Are they defense mechanisms against certain plant diseases or insects? If so, can they be increased or encouraged by particular soil conservation or soil management methods? Experiments to answer these and similar questions could give valuable information about soil antibiotics.

References:

Stallings, J. H., 1954. "Soil-produced antibiotics -- plant disease and insect control." Bacteriological Review 18(2):131-146. June.

NITROGEN-FIXATION BY LEGUME BACTERIA

Nitrogen is indispensable to life processes. Although 80% of the air is pure nitrogen, this element is useless to plants and animals unless it is combined in some form to make it available. Many leguminous plants used as cover crops for soil and water conservation, have a special relationship with bacteria which cause and live in nodules on the roots of most legume plants and bring about this combination, commonly called nitrogen-fixation.

This fixation and its effects can be shown by growing leguminous plants aseptically; and inoculating with pure cultures, crushed nodules or commercial preparations. Some strains of the bacteria are symbiotic with only certain groups of legumes. Different strains may range from highly effective "fixers" to actual parasites, on the same legume. Growing a legume in sterilized soil, in soil from a field in which the legume is growing well, with different strains of nitrogen-fixing bacteria or with the same strain exposed at the time of inoculation to differing amounts of heat or drying, can demonstrate differences which are highly significant in growing these soil-conserving legumes.

References:

Erdman, L. W., Legume Inoculation. What it is. What it does. USDA Farmers Bul. No. 2003, Jan. 1959.

Virtanen, A. I., "The Biological Fixation of Nitrogen and Its Significance for Agriculture," Proceedings of Eighth Congress of the Nordic Assn. of Agri. Res., June 1950 (Copies available from USDA, ASCS, CV).

ESTABLISHING WILDLIFE AREAS

Most farms have out-of-the-way corners of land that are difficult, costly, or impossible to farm. These frequently can make good wildlife areas for birds to nest in if they can get access to other areas for safety. A good stand of grass and bushes provides cover. These are especially fine if a source of food is also provided, or is close by as in grain fields. But such shelters for wild game should take into account the birds or animals and their predators. Such areas ought not to become "traps" by reason of their isolation from other habitat.

There are many back yards and wooded corners that might make good places for birds to nest or rabbits to hide. Check your neighborhood for likely places. Are there grasses and bushes for the rabbits? Are the trees the kind that would discourage cats from climbing? (Cats are notorious bird predators if the birds have no place to keep out of reach.) What is the significance of field borders? What food plants are most desirable and can be planted?

Establish or maintain such areas and exhibit photographs and specimens of such habitat and plants. Existing areas may be identified and included.

References:

Habitat Improvement and other publications of the National Wildlife Federation, Washington, D. C.

Bird habitat publications of the National Audubon Society, 1130 Fifth Ave., New York 28, New York.

POND AND MARSH MANAGEMENT FOR WATERFOWL

Pond environments with continuously stable levels may lose much of their utility to waterfowl through the disappearance of many of the more desirable kinds of waterfowl food plants. Periodic reduction of the water level or even complete drainage and refilling often restores the capability of the pond to produce preferred food and cover plants. This process often occurs under natural conditions in areas of low rainfall, such as the pothole country in the Dakotas, Minnesota, and the Prairie Provinces of Canada. On Federal, State, and other areas managed for waterfowl, deliberate manipulation of water levels are carried out periodically to insure maximum sustained use of these lands and water by wildlife. To maintain highest fertility of the waters, however, the timing of the "draw-down" is important, for the nutrient content of the water varies with the season. Thus, unless timed properly, drainage of impoundments may dissipate nutrient elements from the pond. Changes in pond vegetation and other factors may be determined and exhibited from photographs, charts, specimen collections, etc.

References:

Cook, Arthur H. and Charles F. Powers, New York Fish and Game Journal, January 1958 "Early Biochemical Changes in the Soils and Waters of Artifically Created Marshes in New York," Pages 9-65.

Martin, A. C. and F. M. Uhler, Research Report 30, U. S. Fish and Wildlife Service, USDI, "Food of Game Ducks in the United States and Canada", 308 pages; for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for 75 cents.

1/ Project ideas shown on pages 95-98 were developed at the same time as the material for Chapter Nine "Conservation Projects" but were not included in the chapter.